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(54) Title: METHOD AND SYSTEM OF CHANNEL RESOURCE ALLOCATION
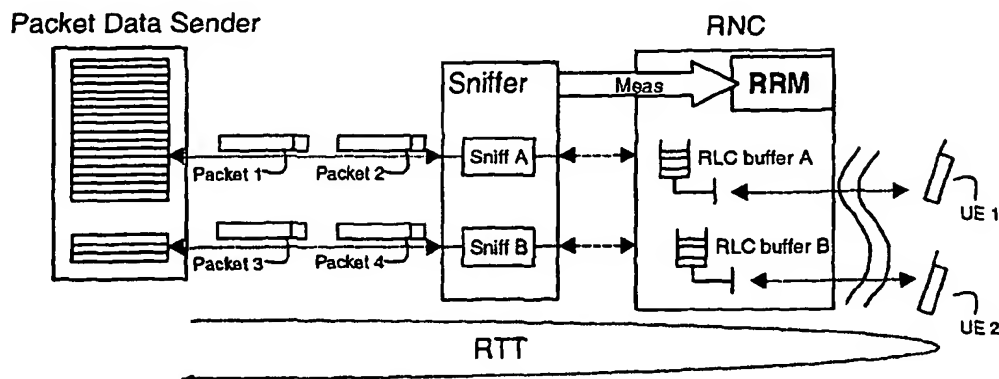
(57) Abstract: The present invention relates to a method and system of transmissions and retransmissions of packet data in a communications system, where the communications system uses switched channels, switching between rates or channels of different characteristics, and connection control and management in such a system. Particularly, the invention relates to radio resource management in a Universal Mobile Telecommunications System, UMTS, or WCDMA system allowing for use of compatible protocols for non-switched and switched channels. Figure for publication.

WO 03/065739 A1

Method and system of channel resource allocation

TECHNICAL FIELD OF THE INVENTION

The present invention relates to transmissions and retransmissions of packet data in a communications system, where

5   the communications system uses rate switching or channel switching. Especially, it relates to transmissions of packet data and channel resource allocation in a cellular mobile radio system, particularly a Universal Mobile Telecommunications System, UMTS, or WCDMA system.

10   **BACKGROUND AND DESCRIPTION OF RELATED ART**

Retransmission of data to or from a mobile station, MS, or User Equipment, UE, is previously known. It is also known to allocate channel resources in a system using rate switching or channel switching.

15   Within this patent application, a radio network controller, RNC, is understood as a network element including an RRM (Radio Resource Management) entity. The RNC is connected to a fixed network. Node B is a logical node responsible for radio transmission/reception in one or more cells

20   to/from a User Equipment. A base station, BS, is a physical entity representing Node B. A server device provides information accessible to other devices over a communications network such as, e.g., the Internet. A client device is a device having access to information provided by one or

25   more devices over a communications network.

With reference to figure 1, base stations «BS 1» and «BS 2» are physical entities representing Nodes B «Node B 1» and «Node B 2» respectively. «Node B 1» and «Node B 2» terminate the air interface, called Uu interface within UMTS,

30   between UE and respective Node B towards the radio network

controller «RNC». «RNC» is connected to a fixed network «Network». The fixed network may comprise one or more Server Devices «Server Device».

Medium access control, MAC, and radio link control, RLC, is
5   used within radio communications systems like General Packet Radio Services, GPRS, and UMTS.

Transport protocols, such as TCP (Transmission Control Protocol), are used widely for "reliable" packet data communications, where reliability refers to its ability to handle
10   retransmissions of data packets that are lost during transmissions and to control transmission rate based on link quality in terms of packet loss and delay characteristics. There are also protocols, such as UDP (Users Datagram Protocol), considered "unreliable" in the sense that they do
15   not themselves inherit retransmissions.

Transport protocol packets carry packets according to application-level protocols such as Hypertext Transfer Protocol (HTTP).

International Patent Application WO9965219 discloses a
20   TCP/IP/PPP modem including an HTML packet sniffer. The HTML packet sniffer interprets the packet header to determine if the data content contains valid HTML data. If so, an HTML rating decoder begins to parse the HTML data for rating tags. An HTTP response parser interprets an HTTP header.

25   *The Internet Society: Request for Comments (RFC) No. 2616, June 1999* describes Hypertext Transfer Protocol 1.1 (HTTP 1.1). Sections 4.4 and 14.13 describe determination of message length.

The Internet Society: Request for Comments (RFC) No. 3135,
30   *June 2001* describes proxy solutions for some explicitly mentioned systems, including systems operating with TCP for

communication links being subject to small bandwidth-delay products, such as W-LANs (Wireless Local Area Networks), W-WANs (Wireless Wide Area Networks) and GSM (Global System for Mobile Communications) or links optimized with small

5   block error rates (BLER), such as satellite links.

U.S. Patent US5673322 describes a split proxy system that encapsulates TCP/IP transmissions into a script transmission.

European Patent Application EP1109359 describes an appara-
10   tus and method for dividing a TCP connection into two con-nections, having congestion control in only one of the two connections.

3rd Generation Partnership Project (3GPP): *Technical Speci-fication Group Radio Access Network, Radio Interface Proto-*
15   *col Architecture, 3GPP TS 25.301 v3.6.0, France, September 2000,* describes an overall protocol structure of a Univer-sal Mobile Telecommunications System (UMTS). There are three protocol layers:

     – physical layer, layer 1 or L1,

20   – data link layer, layer 2 or L2, and

     – network layer, layer 3 or L3.

Layer 2, L2, and layer 3, L3 are divided into Control and User Planes. Layer 2 consists of two sub-layers, RLC and MAC, for the Control Plane and four sub-layers, BMC, PDCP,
25   RLC and MAC, for the User Plane. The acronyms BMC, PDCP, RLC and MAC denote Broadcast/Multicast Control, Packet Data Convergence Protocol, Radio Link Control and Medium Access Control respectively.

Figure 2 displays a simplified UMTS layers 1 and 2 protocol
30   structure for a Uu Stratum, UuS, or Radio Stratum, between

a User Equipment UE and a Universal Terrestrial Radio Access Network, UTRAN.

Radio Access Bearers, RABs, are associated with the application for transportation of services between core network, CN, and User Equipment, UE, through a radio access network. Each RAB is associated with quality attributes such as service class, guaranteed bit rate, transfer delay, residual BER, and traffic handling priority. An RAB may be assigned one or more Radio Bearers, RBs, being responsible for the transportation between UTRAN and UE. For each mobile station there may be one or several RBs representing a radio link comprising one or more channels between UE and UTRAN. Data flows (in the form of segments) of the RBs are passed to respective Radio Link Control, RLC, entities which amongst other tasks buffer the received data segments. There is one RLC entity for each RB. In the RLC layer, RBs are mapped onto respective logical channels. A Medium Access Control, MAC, entity receives data transmitted in the logical channels and further maps logical channels onto a set of transport channels. In accordance with subsection 5.3.1.2 of the 3GPP technical specification MAC should support service multiplexing e.g. for RLC services to be mapped on the same transport channel. In this case identification of multiplexing is contained in the MAC protocol control information.

Transport channels are finally mapped to a single physical channel which has a total bandwidth allocated to it by the network. In frequency division duplex mode, a physical channel is defined by code, frequency and, in the uplink, relative phase (I/Q). In time division duplex mode a physical channel is defined by code, frequency, and time-slot. As further described in subsection 5.2.2 of the 3GPP technical specification the L1 layer is responsible for er-

ror detection on transport channels and indication to
higher layer, FEC encoding/decoding and interleav-
ing/deinterleaving of transport channels.

PDCP provides mapping between Network PDUs (Protocol Data
5   Units) of a network protocol, e.g. the Internet protocol,
to an RLC entity. PDCP compresses and decompresses redun-
dant Network PDU control information (header compression
and decompression).

None of the cited documents above offers a method and sys-
10   tem of retrieving channel resource requirements in systems
using channel resource management, involving rate switching
or channel switching, allowing for identical or same-type
transport or application-level protocols for fixed and
switched rates/channels. Nor do they provide an interface
15   to channel resource management.

SUMMARY OF THE INVENTION

A system according to prior art includes buffering of data
in a Radio Network Controller. This causes delay and
round-trip time latency. I.e., the time for a user or user
20   application to perceive a response to transmitted data or
undertaken action from the receiving end is not immediate,
but should be kept as small as possible.

With systems using channel resource management, such as ra-
dio resource management in UTRAN it is greatly desirable,
25   however difficult to achieve, a method and system where
channel resource can be allocated in a best match to data
objects to be transferred over the channel introducing no
or negligible additional delay.

Buffering of data for predictions causes delay of (one-way)
30   data destined for a User Equipment. Protocols originally
designed for wireline transmission, e.g. TCP (Transmission

5

WO 03/065739

Control Protocol), can introduce further delay due to use of congestion algorithms behaving as if the channel were congested if not properly managing channel resources.

5 For data transmissions over link protocols with relatively small buffer sizes, evaluation of the need for capacity of existing connections and allocation of capacity to new connections for best-fit matching of data requirements are difficult or impossible.

10 Consequently, it is an object of this invention to increase utilization of channel resources of a channel switching system.

It is also an object of this invention to eliminate or reduce delay and latency as perceived by a user.

15 A related object is to reduce delay and latency as perceived by a congestion control algorithm with applications such as Internet connections over a radio link in a WCDMA (Wideband Code Division Multiple Access) system.

A further object is to enable or simplify allocation and management of capacity to new and existing connections, in-
20 cluding evaluation and prediction of capacity needs for various connections.

Finally, it is an object to accomplish the above mentioned objects without requiring interference of or operations on layer 3 semantics.

25 These objects are met by the invention, which is particularly well suited for a Universal Mobile Telecommunications System, UMTS, providing an interface between a sniffer device and channel resource management, particularly radio resource management.

Preferred embodiments of the invention, by way of examples, are described with reference to the accompanying drawings below.

BRIEF DESCRIPTION OF THE DRAWINGS

5   Figure 1 shows communication between a UE and a base station involved in a connection between an RNC and the UE.

Figure 2 displays a layered protocol structure, according to prior art, in a radio communications system.

Figure 3 displays a first embodiment for radio resource
10   control, according to the invention.

Figure 4 illustrates schematically a second embodiment for radio resource control, according to the invention.

Figure 5 displays a third embodiment for radio resource control, according to the invention.

15   Figure 6 shows a fourth embodiment for radio resource control, according to the invention.

Figure 7 shows a stand-alone sniffer sniffing data requests in uplink direction or data responses in downlink direction, according to the invention.

20   Figure 8 illustrates a sniffer sniffing data requests in uplink direction or data responses in downlink direction integrated with RNC, according to the invention.

Figure 9 illustrates a sniffer sniffing data requests in downlink direction or data responses in uplink direction,
25   according to the invention.

Figure 10 illustrates a sniffer sniffing data requests in downlink direction or data responses in uplink direction integrated with RNC, according to the invention.

Figure 11 shows a block diagram with a stand-alone sniffer sniffing data requests in downlink direction or data responses in uplink direction connected to a User Equipment, according to the invention.

5   Figure 12 illustrates an exemplary sniffer sniffing data requests in downlink direction or data responses in uplink direction integrated with a User Equipment, according to the invention.

Figure 13 shows a block diagram with a stand-alone sniffer
10 sniffing data requests in uplink direction or data responses in downlink direction connected to a User Equipment, according to the invention.

Figure 14 illustrates an exemplary sniffer sniffing data requests in uplink direction or data responses in downlink
15 direction integrated with a User Equipment, according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

As an example illustrating the fundamentals of the invention consider a User Equipment «UE/Client Device» of figure
20 1 requesting data from a network server «Server Device», responding by transmitting the requested data. In most application-level protocols the data request or the data response includes information on size of the requested data object. This information is passed through radio network
25 controller «RNC» and base station «BS 2/Node B 2». As a non-exclusive example, the specification of HTTP 1.1, widely used in the Internet, specifies the header of a response to a data request to comprise such information. This information is of great value for management of
30 strictly limited channel resources between base station «BS 2/Node B 2» and User Equipment «UE/Client Device».

Retrieval of data object size included as one or more data
packet elements can be achieved by passing packet data
through or by a processing entity identifying or recogniz-
ing the relevant one or more data packet elements as they
5   appear, in the sequel denoted as sniffing.

Figure 3 displays a first embodiment for radio resource
control, according to the invention. A «Packet Data
Server», e.g. a Web Server corresponding to «Server Device»
of figure 1, transmits data packets to a User Equipment
10   «UE» being client device.

Data packets «Packet 1», «Packet 2», «Packet 3», «Packet 4»
are transmitted from the Packet Data Sender through a net-
work to a Radio Network Controller. In accordance with
UTRAN technical specifications, RNC includes an RLC proto-
15   col layer, as schematically illustrated in figure 2. «RNC»
communicates with User Equipment «UE 1», «UE 2». The RNC
comprises Radio Resource Management «RRM» undertaking radio
resource control, assigning and switching channel re-
sources. According to prior art, RRM relies on local traf-
20   fic measurements in «RNC» and there are only limited means
for distinguishing different traffic or data dependent
needs for channel resources of different connections of the
RNC. There is a sender-receiver relationship between «RNC»
and «UE 1» and «UE 2», respectively. Packets transmitted
25   from RLC protocol entity residing in RNC are acknowledged
by User Equipment «UE 1», «UE 2». The sender-receiver re-
lationship is subject to latency due to a round-trip delay
between RNC and User Equipment «UE1», «UE2» included in the
end-to-end round-trip delay time «RTT» as indicated in fig-
30   ure 3. Assuming that User Equipments «UE 1», «UE 2» are
using an application making use of e.g. HTTP over TCP, such
as web browsing, the Packet Data Sender «Data Sender» the
transmits exemplary HTTP packets in TCP packets to be ac-

knowledged by the respective client devices «UE 1», «UE 2».
To avoid confusion, "application protocol acknowledgements"
refer to acknowledgements associated with the L3 network
layer and "RLC acknowledgements" refer to acknowledgements

5   associated with the L2/RLC protocol layer. As the applica-
tion protocol acknowledgements and the RLC acknowledgements
are nested, the application protocol acknowledgments will
perceive an increasing round-trip time delay as the RLC ac-
knowledgements round-trip time increases.

10 As a user moves with his User Equipment away from a base
station «BS 1» towards another base station «BS 2» in fig-
ure 1, the connection between UE and RNC is likely to be
rerouted from being over a first Node B «Node B 1» to being
over a second Node B «Node B 2» or over both «Node B 1» and

15 «Node B 2» using soft handover. In figure 1, the base sta-
tions are connected to the same radio network controller
RNC. However, the invention also covers the exemplary
situation where the base stations are connected to differ-
ent RNCs. In UMTS, the RLC protocol is terminated in a

20 serving RNC, SRNC, responsible for interconnecting the ra-
dio access network of UMTS to a core network.

An aspect of the invention is that according to prior art
there is a risk of radio resources being underutilized and
users experiencing increased latencies and delays or even

25 the connection being broken. There is also a risk for the
transfer from the data provider to stall.

In UMTS, existing RLC protocols operate with limited buffer
sizes. One reason for this is delay constraints. Accord-
ing to prior art data throughput and buffer status measure-

30 ments provide very limited information on the future band-
width needs of a connection. Buffer fill level and data
throughput measurements provide no means to distinguish

whether the packets presently loading the link are the last few of a transfer, or if there remains a lot of data at the sender still to be transmitted. Consequently, evaluation of data-related need for capacity of existing connections and allocation of capacity to new connections are difficult or impossible. There is no information in RLC buffer on how large objects a client is retrieving from the Packet Data Sender, e.g. downloading, to estimate a user's near-future need, associated with the data he is retrieving, for channel capacity.

As a non-exclusive example illustrating a problem of prior art, RRM may perform a channel up-switch, allocating more channel capacity to a connection, at a moment when the last bits of a data transfer have been transmitted leading to waste of channel resource of no value to the user obtaining data bandwidth increase, reducing the data bandwidth available to other connections of a scarce shared channel resource.

The problem cannot be solved by increasing RLC buffer size, as long as the RLC buffer is part of an end-to-end-delay of a connection between a data provider and an end user, where the data provider awaits application protocol acknowledgements from the user, since increasing RLC buffer size would introduce additional delay and require extensive time-out limits.

Another aspect of the invention, related to problem in prior art, is evaluation when there is a plurality of on-going connections. It is difficult or impossible for the channel resource management, such as RRM (Radio Resource Management) in UMTS, to evaluate which connection or connections of a plurality of active ones that is in need for more capacity or bandwidth.

11

An advantage of introducing a sniffer according to the invention is that the needs of individual users/clients can be predicted or information on future needs be retrieved before the need appears, in contrast to prior art. From
5   information on object sizes channel resources can be appropriately allocated according to the needs as predicted or retrieved.

A problem related to a transport protocol such as TCP and channel switching is that sudden buffer drainage in RLC
10   buffer, or corresponding prior art buffer, or low throughput due to, e.g., TCP loss recovery or great variations in packet delays may trigger unwanted channel down switch if, e.g., channel resource management interprets data transmissions to have ended notwithstanding a lot of data remain to
15   be sent from the data provider. A straightforward solution to avoid channel down-switching is to have extensive prohibit time delays prohibiting channel down-switching during a predefined time frame beginning at the first instance of indication of a broken connection or a connection with less
20   need for capacity. However, such a solution would be inefficient in a channel resource perspective, prohibiting other connections to access channel resources of truly broken connections during the prohibit time frame, leaving scarce channel resources underutilized.

25   The present invention provides a solution also to this problem. Interfacing the data provider in close relation to channel resource management, such as RRM in UMTS, enables the data provider to proceed data transmissions. This will prevent data transmissions from getting stalled
30   due to channel resources being poorly distributed to the various data streams, allowing for improved prediction of channel capacity to allocate. Consequently, prohibit time frames for channel down switching can be reduced or elimi-

nated, increasing utilization of scarce channel resources,
such as radio channel resources.

The present invention provides for efficient channel
switching and good radio resource utilization of particu-

5   larly a UMTS system, but also applies to other systems us-
ing packet services such as GPRS, enabling reliable predic-
tions of future bandwidth needs of connections close to ra-
dio resource management, generally located in RNC.

Figure 4 illustrates schematically a second embodiment for

10   radio resource control according to the invention. Figure
4 corresponds in a plurality of aspects to figure 3. Data
packets «Packet 1», «Packet 2», «Packet 3» and «Packet 4»
are transmitted from a Packet Data Sender. The data pack-
ets destined for User Equipments «UE 1», «UE 2» are routed

15   by radio network controller «RNC». Data is passed through
a sniffer device «Sniffer» comprising at least one sniffing
entity «Sniff A», «Sniff B», sniffing data streams passing
through «RNC» and «Sniffer» for information on data object·
size(s). In figure 4, and also in figure 3, signaling

20   «Meas» carrying information revealing size of data ob-
ject(s) for reserving and allocating channel resources cor-
responding to revealed data object size(s) is transferred
«Meas» from the sniffer device «Sniffer» to radio resource
management «RRM». Channel allocation is determined by ra-

25   dio· resource management, RRM, depending on estimated re-
source requirement as indicated by signaling «Meas» from
device «Sniffer» to RNC-entity «RRM». The signaling can be
transferred individually for each sniffing entity,
«Sniff A», «Sniff B» or collectively for a plurality of

30   sniffing entities in sniffer device «Sniffer». In figure
4, the sniffer entity «Sniff A», «Sniff B» is included in a
stand-alone unit «Sniffer», connected to a radio network
controller «RNC», whereas in figure 3 the one or more

sniffing entities «Sniff A», «Sniff B» are included in
«RNC».

Figures 5 and 6 display a third and forth embodiment, re-
spectively, for radio resource control, according to the
5   invention. According to the third and fourth embodiments,
the sniffer comprises buffers of sizes sufficiently large
to store objects of data, in their entirety or in part, to
be transmitted to the client. The sniffer solution does
not exclude splitting the application protocol connection
10   between «Packet Data Sender» and client «UE 1», «UE 2» into
two parts. This is the case for the embodiment in figures
5 and 6, with the sniffer in a stand-alone device connected
to RNC and in figure 6, where it is integrated in RNC.
Again, data in one direction, particularly downlink direc-
15   tion, is sniffed for information on block-sizes, e.g. HTTP
content-length, to be used for radio resource management in
«RRM». Block-size data is transferred «Meas» from «Snif-
fer» to «RRM».

A particular advantage is achieved if a connection such as
20   a TCP-connection is split into sub-connections, acknowledg-
ing correctly received data packets, for an individual sub-
connection, thereby reducing round-trip time latency and
jitter.

Buffered data can be made further use of to predict the
25   need for channel resources to transmit the data packets of
the objects. Thereby, reliability and timeliness of radio
resource control, based upon data from «Sniffer» can be
further increased.

In the fourth embodiment of figure 6, the buffers of the
30   sniffer are made use of also for RLC buffering. Figures 3,
4 and 5 are illustrated to comprise dedicated RLC buffers
for this purpose.

14

Figure 7 shows a block diagram with a stand alone sniffer unit «Sniffer» connected to a universal terrestrial radio access network «UTRAN», according to the invention. The sniffer includes one or more sniffing entities «Sniff»,

5   sniffing data requests «Req» in uplink direction, data responses «Data» in downlink direction or both. A data sender «Data Sender» transmits upon request «Req» data «Data» destined for a user of a User Equipment «UE» in a communications system including an exemplary universal ter-

10   restrial radio access network «UTRAN» providing data for «UE». Universal terrestrial radio access network «UTRAN» sends data «Data» to User Equipment «UE» over a switched channel. User Equipment «UE» acknowledges received data, positively or negatively. Data from «Data Sender» is re-

15   ceived and is optionally acknowledged «Ack» in a data receiver «DataRec» in «Sniffer». In the case of sniffer application protocol acknowledgements, received data is cached or stored in a data buffer «Buffer» in «Sniffer». The buffered data is used for determining data related to

20   radio resource allocation «Meas», e.g. block-size data, for radio resource management «RRM» in UTRAN. Data is transferred from «Sniffer» to its destination «UE» on a switched channel as established by UTRAN. In the case of sniffer application protocol acknowledgements, UE acknowledges re-

25   ceived data towards the sniffer in place of data sender. Upon reception of such application protocol acknowledgement, data need not be stored any further for the acknowledging destination and is preferably released from «Buffer».

30   The invention does not require separate application protocol acknowledgements by sniffer, interfering layer 3 semantics or breaking an end-to-end link. Thereby, the sniffer can be made more or less insensitive to e.g. associated problems related to handover of buffer content.

Irrespective of whether or not data is acknowledged by
«Sniffer», it sniffs data for information on link require-
ments. Measurements «Meas» on link requirements forming a
basis for radio resource allocation are transferred from
5   «Sniffer» to radio resource management «RRM». Data re-
quested by UE is transferred to data sender via «UTRAN».
Preferably, the sniffer forms part of an extended UTRAN.

Figure 8 illustrates a performance enhancing proxy «Snif-
fer», according to the invention, integrated with radio
10   network controller «RNC», being part of «UTRAN» in an exem-
plary WCDMA system. As with figure 7, also the sniffer
device «Sniffer» in figure 8 sniffs data requests «Req» in
uplink direction, data responses «Data» in downlink direc-
tion or both. Transmissions and devices are similar to
15   those of figure 7, labeled correspondingly.

Figure 9 shows an embodiment of the invention sniffing data
requests «Req» in downlink direction, data responses «Data»
in uplink direction or both. The sniffer «Sniffer» com-
prises one or more sniffing entities «Sniff» for sniffing
20   data requests «Req» or data responses «Data». Depending on
sizes of data objects, radio resource management «RRM» al-
locates radio resources of a switched channel. Of course,
the sniffers of figure 7 and 9 can be incorporated into one
single sniffer entity sniffing requests in both downlink
25   and uplink directions. As for figure 7, also the sniffer
of figure 9 preferably forms part of an extended UTRAN.

Figure 10 shows an embodiment with «Sniffer», corresponding
to «Sniffer» of figure 9, integrated in radio network con-
troller «RNC» of «UTRAN». Entities corresponding to those
30   of figure 9 have been labeled correspondingly.

Figure 11 shows a block diagram with a stand-alone sniffer
unit «Sniffer» connected to a User Equipment «UE» according

16

to the invention. The sniffer, sniffing data requests
«Req» in downlink direction, data responses «Data» in
uplink direction or both, can be connected to User Equip-
ment «UE» on Data Sender side or on UTRAN side of User

5   Equipment «UE». A data sender «Data Sender» transmits data
destined for a Data Receiver or Server Device (not included
in the figure) in a network behind an exemplary universal
terrestrial radio access network «UTRAN» over a switched
channel as established by UTRAN.

10   A data receiver «DataRec» in the sniffer device «Sniffer»
receives data from «Data Sender». The sniffer device
«Sniffer» can optionally acknowledge «Ack» data received
from «Data Sender», positively or negatively. For this
case, received data is cached or stored in an optional data

15   buffer «Buffer», as described in relation to figure 7.

Data requests «Req» or data responses «Data» passed through
the sniffer are analyzed for size of requested objects.
Optionally buffered data may be used for further measure-
ments or extraction of prediction data. Data on requested

20   object sizes and optionally further measurements or predic-
tion data «Meas» is transferred to radio resource manage-
ment «RRM» in UTRAN. Prediction data «Meas» is transferred
from «UE» to «UTRAN» on a switched channel as established.
This can be identically the same channel used for payload,

25   as well as another channel. However, for reasons of sim-
plicity, a separate dashed line between «Sniffer» and «UE»,
and a single dashed line from «UE» to «UTRAN» indicate the
transfer. Radio resource management data «RRinfo» for rate
and channel selection is transferred from «UTRAN» to «UE»

30   on a downlink channel. For reasons of clarity this is in-
dicated by a separate dashed line between «UTRAN» and «UE».

Figure 12 illustrates an exemplary sniffer device «Sniffer» according to the invention. The sniffer, sniffing data requests «Req» in downlink direction, data responses «Data» in uplink direction or both, is integrated with a User

5   Equipment «UE», preferably a User Equipment of a WCDMA system. Transmissions and devices are similar to those of figure 11 labeled correspondingly.

Also requests for data in uplink direction and their responses in downlink direction can be analyzed by a sniffer

10   associated with a User Equipment, if appropriate.

Figure 13 shows a block diagram with a stand-alone sniffer unit «Sniffer» being connected to a User Equipment «UE» according to the invention. The sniffer, sniffing data requests in uplink direction, data responses in downlink di-

15   rection or both, can be connected to User Equipment «UE» on Data Sender side or on UTRAN side of User Equipment «UE». A data receiver «Data Receiver» receives data from a Data Sender or Server Device (not included in the figure) in a network behind an exemplary Universal Terrestrial Radio Ac-

20   cess Network «UTRAN» over a switched channel as established by UTRAN.

Data requests or data responses passed through the sniffer are analyzed for size of data objects. Data on object sizes and optionally further measurements or prediction

25   data «Meas» is transferred to radio resource management «RRM» in UTRAN. Prediction data «Meas» is transferred from «UE» to «UTRAN» on a switched channel as established. This can be identically the same channel used for payload, as well as another channel. However, for reasons of simplic-

30   ity, a separate dashed line between «Sniffer» and «UE», and a single dashed line from «UE» to «UTRAN» indicate the

transfer. Radio resource management allocates channel re-
sources in «UTRAN».

Figure 14 illustrates an exemplary sniffer device «Sniffer»
according to the invention. The sniffer, sniffing data re-
5   quests in downlink direction, data responses in uplink di-
rection or both, is integrated with a User Equipment «UE»,
preferably a User Equipment of a WCDMA system. Transmis-
sions and devices are similar to those of figure 13 labeled
correspondingly.

10   Of course, various combinations of sniffing entities
«Sniff» of figures 7-14 can be combined to achieve an in-
terface to radio resource management sniffing uplink and
downlink directions in different entities. A particular
·advantage of the invention is that sniffing of both uplink
15   and downlink directions can be accomplished in one single
sniffer device, e.g. located in RNC.

Preferably, all retransmission entities, interconnecting
networks or channels of different characteristics, e.g.
RNCs in UMTS, operate according to the invention for out-
20   standing performance. However, the invention can also be·
used in systems also including retransmission entities,
such as RNCs, not operating according to the invention.

A person skilled in the art readily understands that the
receiver and transmitter properties of a BS or a UE are
25   general in nature. The use of concepts such as BS, UE or
RNC within this patent application is not intended to limit·
the invention only to devices associated with these acro-
nyms. It concerns all devices operating correspondingly, ·
or being obvious to adapt thereto by a person skilled in
30   the art, in relation to the invention. As an explicit non-
exclusive example the invention relates to mobile stations
without a subscriber identity module, SIM, as well as user

equipment including one or more SIMs. Further, protocols and layers are referred to in close relation with UMTS and Internet terminology. However, this does not exclude ap-plicability of the invention in other systems with other

5   protocols and layers of similar functionality.

The invention is not intended to be limited only to the em-bodiments described in detail above. Changes and modifica-tions may be made without departing from the invention. It covers all modifications within the scope of the following

10   claims.

CLAIMS

1.   A method of channel resource allocation in a communi-
cations system, the method c h a r a c t e r i z e d   i n
that the communications system uses one or more switched
channels, switching between rates or channels of different
5   characteristics and that one or more data transmissions to
or from a data provider are investigated or sniffed for in-
formation related to data object size.

2.   The method according to claim 1 c h a r a c t e r -
i z e d   i n that radio resource allocation is based upon
10   the information related to data object size.

3.   The method according to claim 2 c h a r a c t e r -
i z e d   i n that resource allocation comprises selection
of one or more channels or channel characteristics.

4.   The method according to any of claims 1-3 c h a r -
15   a c t e r i z e d   i n that the one or more data transmis-
sions are sniffed or investigated in application-level data
packets.

5.   The method according to any of claims 1-4 c h a r -
a c t e r i z e d   i n that the one or more data transmis-
20   sions are investigated or sniffed in uplink direction.

6.   The method according to any of claims 1-4 c h a r -
a c t e r i z e d   i n that the one or more data transmis-
sions are investigated or sniffed in downlink direction.

7.   The method according to any of claims 1-6 c h a r -
25   a c t e r i z e d   i n that radio resource management al-
locates resources based upon prediction from the informa-
tion related to data object size.

8.   The method according to claim 7 c h a r a c t e r -
i z e d   i n   that resource allocation comprises selection
of one or more channels or channel characteristics.

9.   The method according to any of claims 1-8 c h a r -
5   a c t e r i z e d   i n   that the channel characteristics
include at least one of

         - data rate,

         - dedicated or shared usage,

         - scheduling,

10   - modulation,

         - spreading code spreading factor, and

         - transmission power.

10. The method according to any of claims 1-9 c h a r -
a c t e r i z e d   i n   that user or session individual
15   data from the data provider is cached or stored prior to
being transmitted over a switched channel.

11. The method according to any of claims 1-10 c h a r -
a c t e r i z e d   i n   that prediction for resource allo-
cation of a switched channel is based on content of cached
20   or stored data.

12. The method according to claim 10 or 11 c h a r a c -
t e r i z e d   i n   that the data is cached or stored in
association with radio resource management.

13. The method according to any of claims 1-12 c h a r -
25   a c t e r i z e d   i n   that data from the data provider is
positively or negatively acknowledged towards the data pro-
vider and forwarded for transmission over a switched chan-
nel.

14. The method according to any of claims 1-13 c h a r - a c t e r i z e d   i n   that resource allocation prediction of a switched channel is based on amount of acknowledged data.

5   15. The method according to any of claims 1-14 c h a r - a c t e r i z e d   i n   that resource allocation prediction is performed for a connection to be established.

16. The method according to any of claims 1-14 c h a r - a c t e r i z e d   i n   that resource allocation prediction

10   is performed for an established connection.

17. The method according to any of claims 1-16 c h a r - a c t e r i z e d   i n   that it reduces at least one of delay and latency, as perceived by a data receiver at the destination.

15   18. The method according to any of claims 1-16 c h a r - a c t e r i z e d   i n   that it reduces at least one of delay and latency, as perceived by a data provider.

19. The method according to any of claims 1-16 c h a r - a c t e r i z e d   i n   that it reduces at least one of de-

20   lay and latency, as perceived by a congestion control algorithm.

20. The method according to any of claims 1-19 c h a r - a c t e r i z e d   i n   that individual user need of channel resources is predicted from the object size related in-

25   formation.

21. The method according to any of claims 1-19 c h a r - a c t e r i z e d   i n   that future need of channel resources is retrieved from the object size related information before the need appears.

22. The method according to any of claims 1-19 c h a r -
a c t e r i z e d   i n   that the channel resources are
channel resources required to transmit data packets of the
object of said data object size.

5   23. An element for channel resource allocation in a commu-
nications system using switched channels, switching between
rates or channels of different characteristics, the element
c h a r a c t e r i z e d   b y   one or more processing en-
tities for investigating or sniffing one or more data
10 transmissions to or from a data provider, for information
related to data object size.

24. The element according to claim 23 c h a r a c t e r -
i z e d   b y   circuitry for transferring the information
related to data object size to radio resource management.

15 25. The element according to claim 23 or 24 c h a r .a c -
t e r i z e d   b y. one or more processing entities for al-
locating radio resources based upon the information related
to data object size.

26. The element according to claim 25 c h a r a c t e r -
20 i z e d   i n   that resource allocation comprises selection
of one or more channels or channel characteristics.

27. The element according to any of claims 23-26·
c h a r a c t e r i z e d   b y   a radio resource management
entity for resource allocation based upon prediction from
25 the information related to data object size.

28. The element according to any of claims 23-27
c h a r a c t e r i z e d   b y   one or more processing en-
tities for sniffing or investigating data transmissions in
application-level data packets.

29. The element according to any of claims 23-28 c h a r a c t e r i z e d   i n   that the one or more data transmissions are investigated or sniffed in uplink direction.

5   30. The element according to any of claims 23-28 c h a r a c t e r i z e d   i n   that the one or more data transmissions are investigated or sniffed in downlink direction.

31. The element according to any of claims 23-30
10   c h a r a c t e r i z e d   i n   that the channel characteristics include at least one of

          - data rate,

          - dedicated or shared usage,

          - scheduling,

15   - modulation,

          - spreading code spreading factor, and

          - transmission power.

32. The element according to any of claims 23-31 c h a r a c t e r i z e d   b y   one or more memory or stor-
20   age devices for caching or storing user or session individual data from the data provider prior to being transmitted over the switched channel.

33. The element according to any of claims 23-32 c h a r a c t e r i z e d   b y   one or more processing en-
25   tities for resource allocation prediction of a switched channel based on content of cached or stored data.

34. The element according to claim 32 or 33 c h a r a c - t e r i z e d   b y   one or more memory or storage devices

being arranged in association with radio resource management.

35. The element according to claim 32 or 33 c h a r a c -
t e r i z e d   b y   one or more memory or storage devices
being arranged in association with the one or more process-
ing entities for investigating or sniffing one or more data
requests.

36. The element according to any of claims 23-35
c h a r a c t e r i z e d   b y   one or more processing en-
tities for positively or negatively acknowledging data from
the data provider to be forwarded for transmission over a
switched channel.

37. The element according to any of claims 23-36
c h a r a c t e r i z e d   i n   that resource allocation
prediction of a switched channel is based on amount of ac-
knowledged data.

38. The element according to any of claims 23-37
c h a r a c t e r i z e d   i n   that resource allocation
prediction is performed for a connection to be established.

39. The element according to any of claims 23-37
c h a r a c t e r i z e d   i n   that resource allocation
prediction is performed for an established connection.

40. The element according to any of claims 23-39
c h a r a c t e r i z e d   i n   that it reduces at least
one of delay and latency, as perceived at a destination
data receiver.

41. The element according to any of claims 23-39
c h a r a c t e r i z e d   i n   that it reduces at least
one of delay and latency, as perceived at a data provider.

42. The element according to any of claims 23-39 c h a r a c t e r i z e d i n that it reduces at least one of delay and latency, as perceived by a congestion control algorithm.

5   43. The element according to any of claims 23-42 c h a r a c t e r i z e d i n that the element is included in or connected to user equipment.

44. The element according to any of claims 23-42 c h a r a c t e r i z e d i n that the element is con-
10   nected to or included in a radio network controller.

45. The element according to any of claims 23-44 c h a r a c t e r i z e d b y one or more processing entities for predicting individual user need of channel resources from the object size related information.

15   46. The element according to any of claims 23-44 c h a r a c t e r i z e d b y one or more processing entities for retrieving future need of channel resources from the object size related information before the need appears.

20   47. The element according to any of claims 23-44 c h a r a c t e r i z e d i n that the channel resources are channel resources required to transmit data packets of the object of said data object size.

48. A radio communications system c h a r a c t e r -
25   i z e d b y means for carrying out the method in any of claims 1-22.

49. A radio communications system c h a r a c t e r - i z e d b y a plurality of elements according to any of claims 23-47.
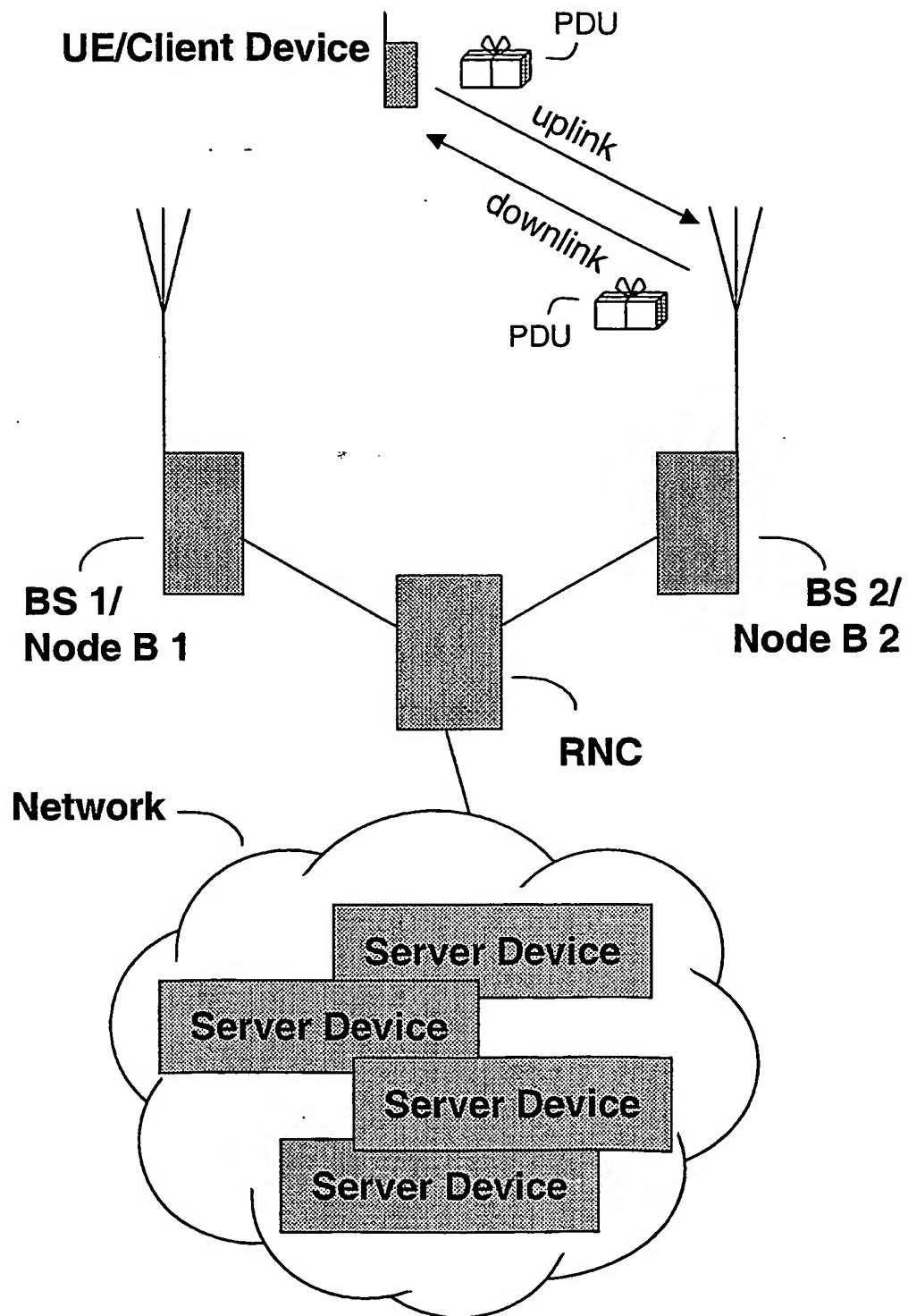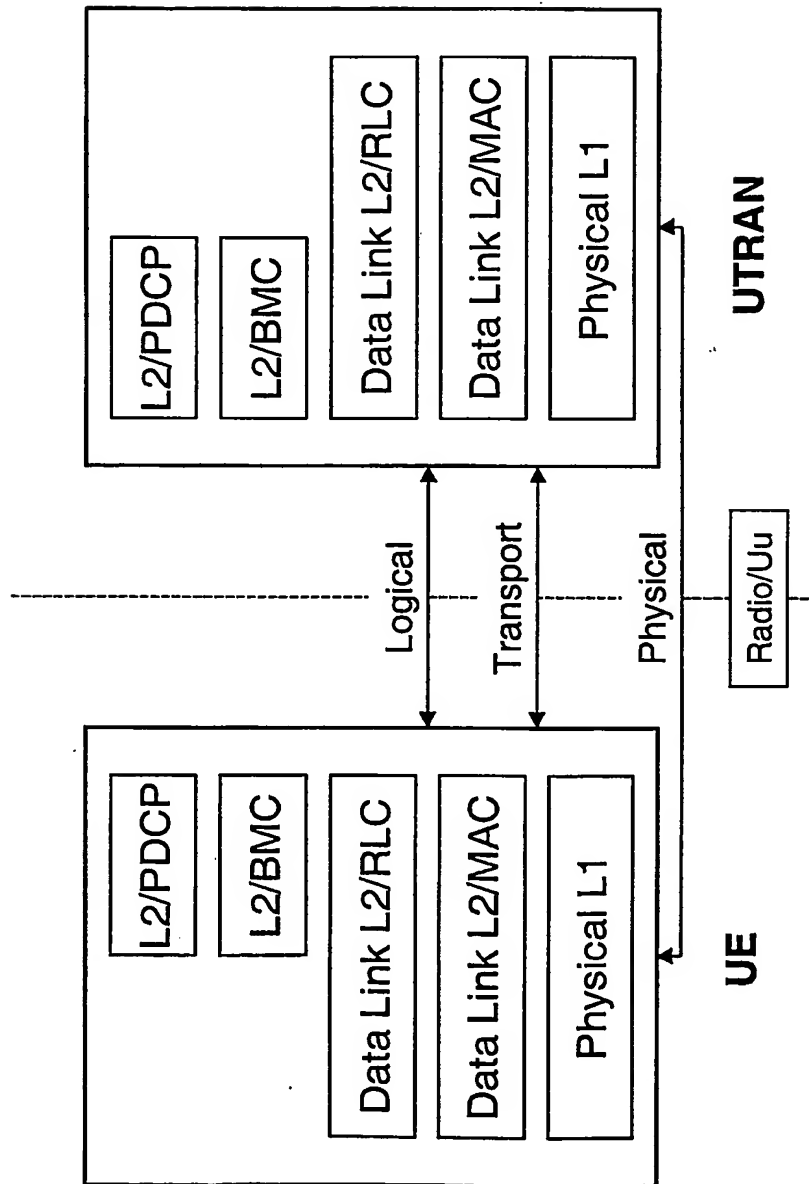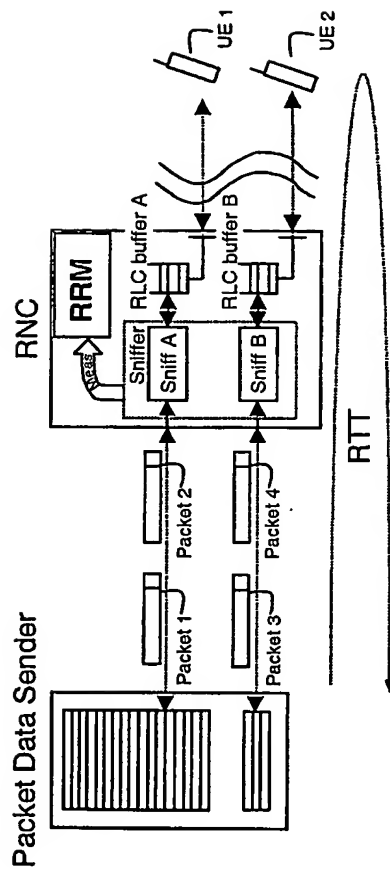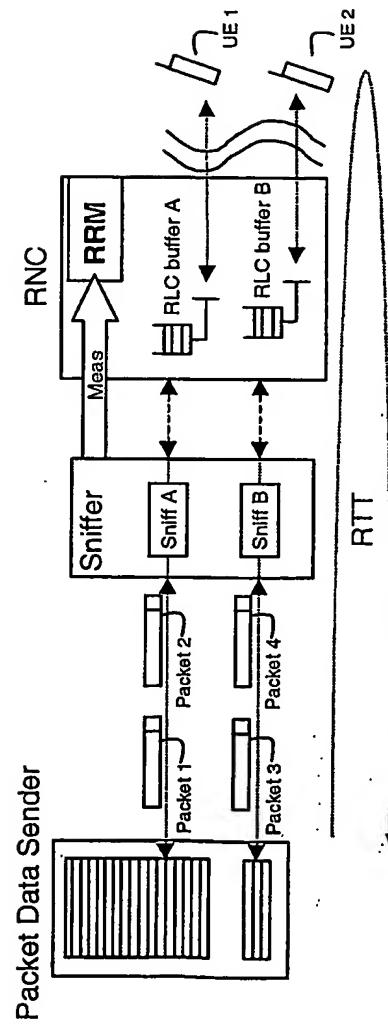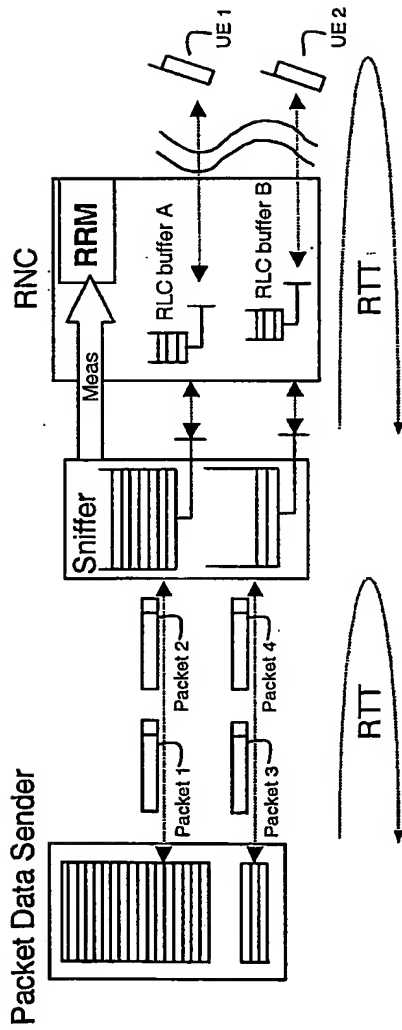
Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

5/8
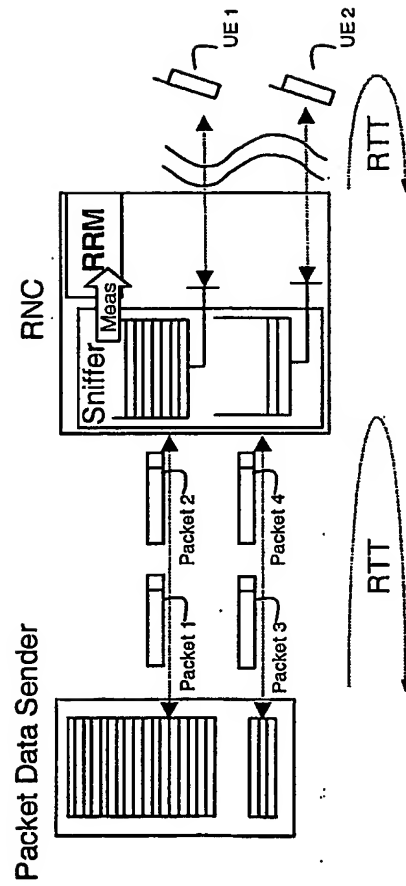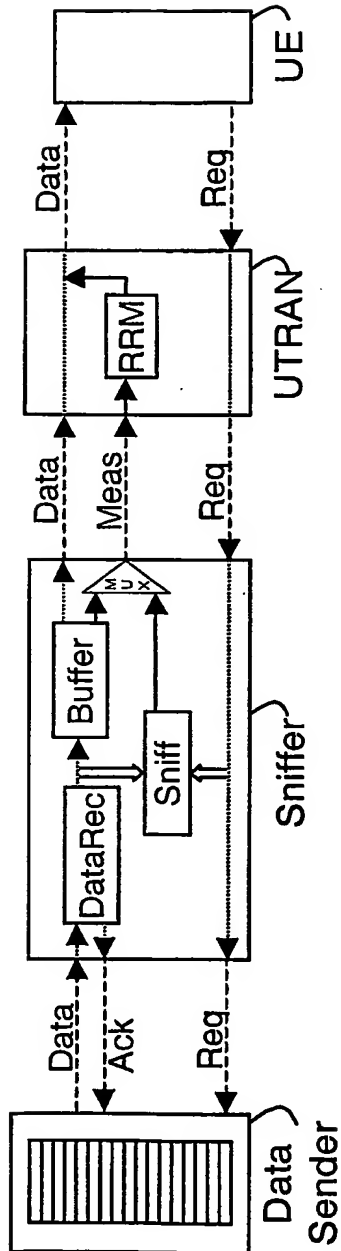
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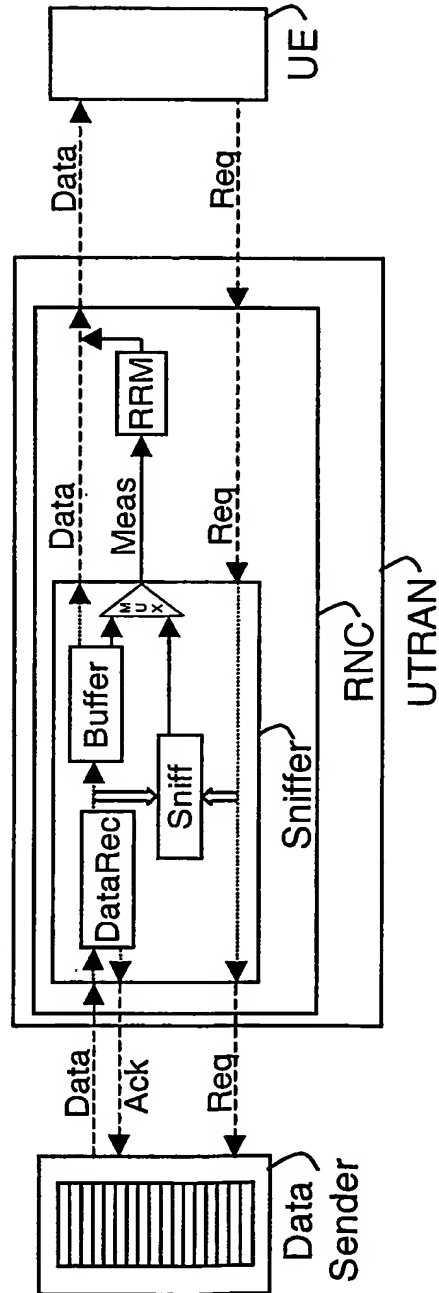
Fig. 8
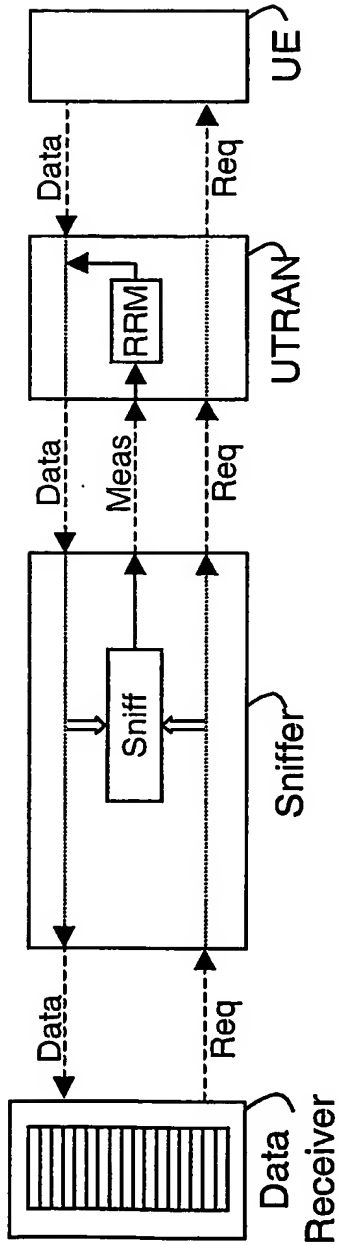
Fig. 9
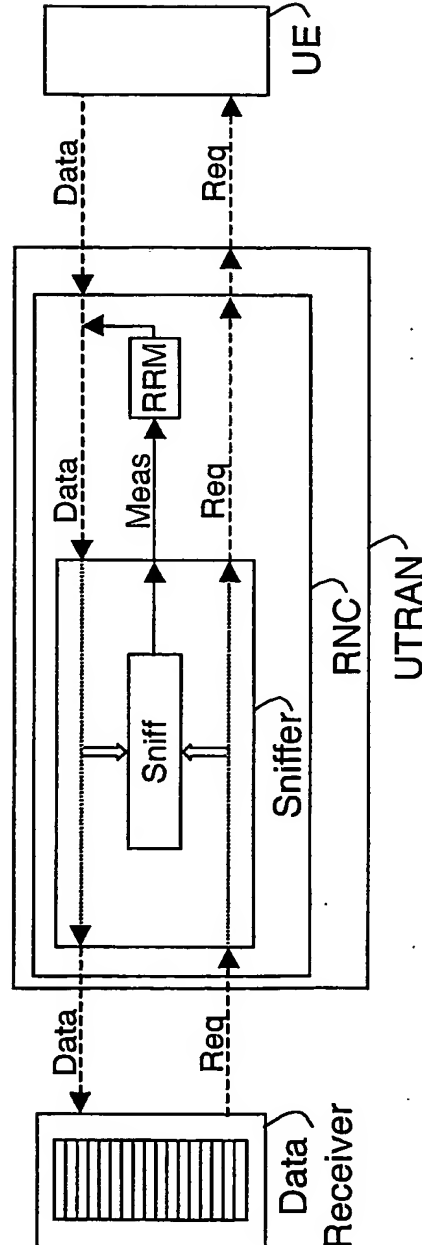
Fig. 10
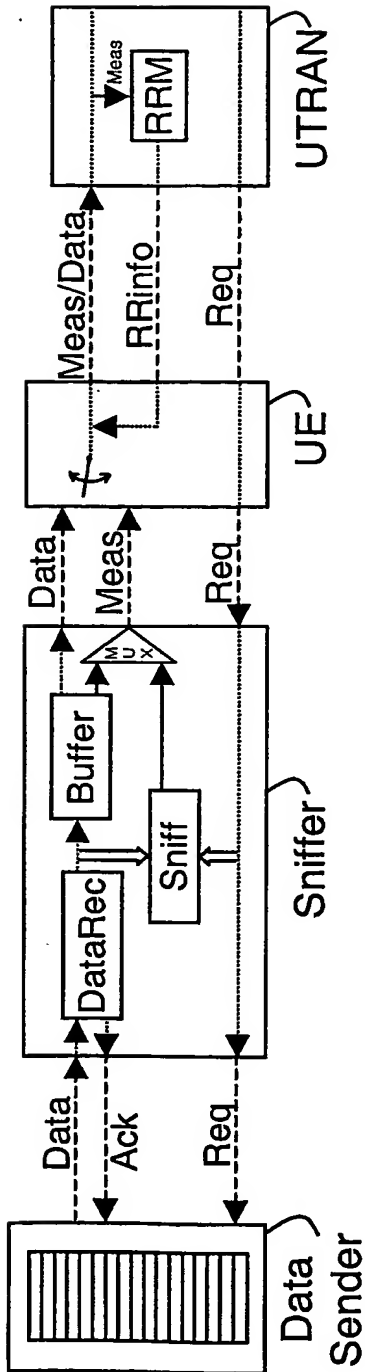
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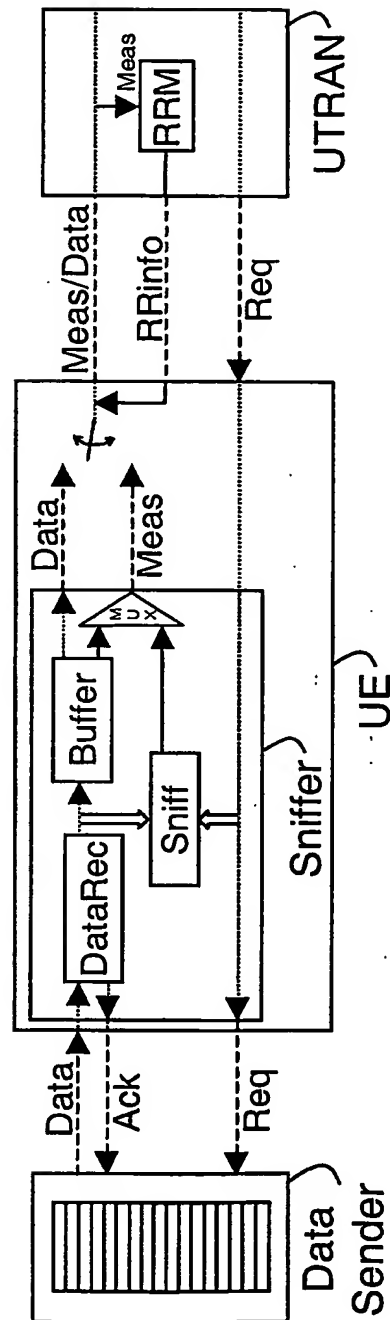
Fig. 12
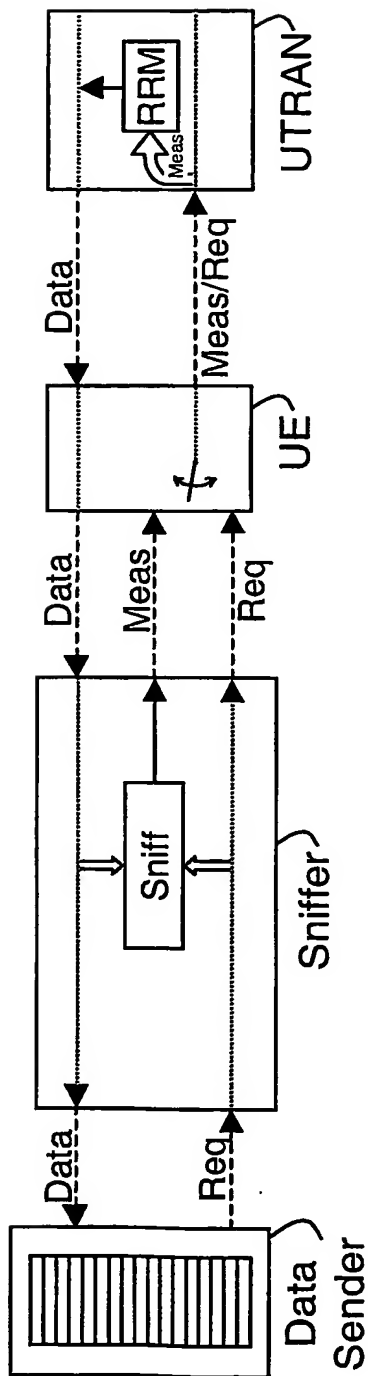
Fig. 13
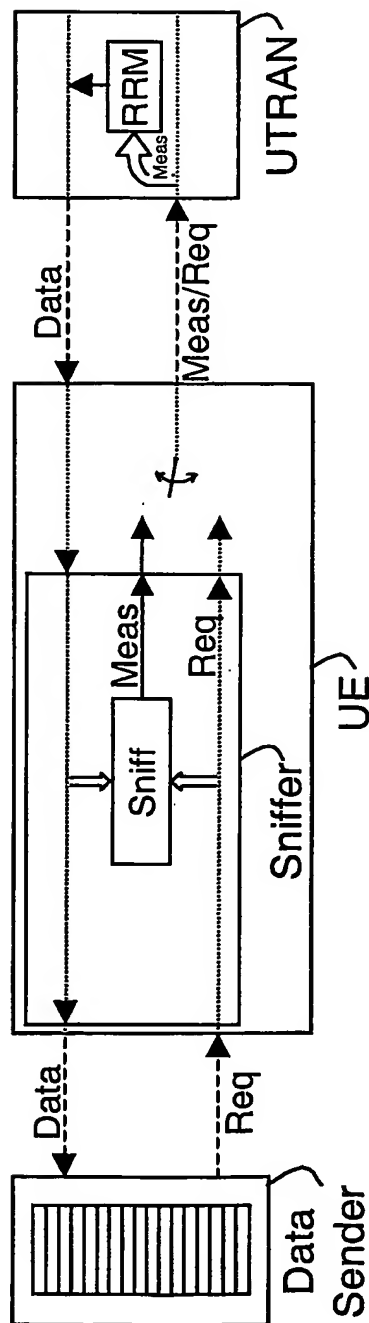
Fig. 14

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/00, H04J 3/00, H04L 12/56
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2351874 A (NEC CORP), 10 January 2001 (10.01.01), page 9, line 11 - page 11, line 6; page 13, line 3 - line 16; page 14, line 5, page 14, line 21 - page 16, line22; page 17, line 5 - line 11; page 17, line 21 - page 21, line 13; abstract	1-9,13-31, 36-49
Y		10-12,32-35
	--	
Y	WO 0016573 A1 (NOKIA MOBILE PHONES LTD), 23 March 2000 (23.03.00), page 4, line 9 - line 13; page 7, line 24 - line 28; page 8, line 10 - page 9, line 12, page 9, line 24 - page, 10, line 1; page 11, line 1 - line 29, figures 1-2, abstract	10-12,32-35
	--	

X	Further documents are listed in the continuation of Box C.		X	See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 April 2003	0 3 -05- 2003

Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ismar Hadziefendic /LR Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5583869 A (GRUBE, G.W. ET AL.), 10 December 1996 (10.12.96), figures 1-5, claims 1-24, abstract, whole document	1-9,13-31, 36-49
	--	
A	US 5793744 A (KANERVA, M. ET AL), 11 August 1998 (11.08.98), column 1, line 1 - column 4, line 55, claims 1-24, abstract	1-49
	--	
A	US 5359593 A (DERBY, J.H. ET AL), 25 October 1994 (25.10.94), column 1, line 1 - column 2, line 68, figure 3, claims 1-4,6-9, abstract	1-49
	--	

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
GB	2351874	A	10/01/01	GB	0011566 D	00/00/00
				JP	2000324164 A	24/11/00
WO	0016573	A1	23/03/00	AU	5749899 A	03/04/00
				AU	5749999 A	03/04/00
				EP	1112664 A	04/07/01
				EP	1114561 A	11/07/01
				FI	110048 B	00/00/00
				FI	982002 A	17/03/00
				FI	982643 A	17/03/00
				US	6490271 B	03/12/02
				WO	0016572 A	23/03/00
US	5583869	A	10/12/96	AU	3199995 A	26/04/96
				CN	1074878 B	14/11/01
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				GB	2324686 A,B	28/10/98
				GB	9610730 D	00/00/00
				GB	9815324 D	00/00/00
				WO	9610875 A	11/04/96
US	5793744	A	11/08/98	AU	714170 B	23/12/99
				AU	1099497 A	14/07/97
				CA	2210861 A	26/06/97
				CN	1091986 B	02/10/02
				CN	1176030 A	11/03/98
				EP	0809901 A	03/12/97
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				FI	956087 A	19/06/97
				JP	11501185 T	26/01/99
				NO	973765 A	15/08/97
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US	5359593	A	25/10/94	EP	0643514 A,B	15/03/95
				JP	2794082 B	03/09/98
				JP	7087102 A	31/03/95

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

· (PCT Article 36 and Rule 70)

Applicant's or agent's file reference P1587WO1	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/SE2003/000176	International filing date *(day/month/year)* 31-01-2003	Priority date *(day/month/year)* 31-01-2002

International Patent Classification (IPC) or national classification and IPC
H04Q 7/00, H04J 3/00, H04L 12/56

Applicant

Telefonaktiebolaget L M Ericsson (publ) et al

1.   This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2.   This REPORT consists of a total of ___5___ sheets, including this cover sheet.

3.   This report is also accompanied by ANNEXES, comprising:

   a.   ☒   *(sent to the applicant and to the International Bureau)* a total of ___8___ sheets, as follows:

   ☒   sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

   ☐   sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b.   ☐   *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))

   _____ , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4.   This report contains indications relating to the following items:

   ☒   Box No. I   Basis of the report

   ☐   Box No. II   Priority

   ☒   Box No. III   Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

   ☐   Box No. IV   Lack of unity of invention

   ☒   Box No. V   Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

   ☐   Box No. VI   Certain documents cited

   ☐   Box No. VII   Certain defects in the international application

   ☐   Box No. VIII   Certain observations on the international application

Date of submission of the demand 04-07-2003	Date of completion of this report 19-04-2004
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Marianne Engdahl /LR Telephone No. +46 8 782 25 00

Form PCT/IPEA/409 (cover sheet) (January 2004)

Box No. I	Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____ , which is the language of a translation furnished for the purposes of:

    ☐ international search (under Rules 12.3 and 23.1(b))

    ☐ publication of the international application (under Rule 12.4)

    ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

    pages   **1-20** _____ as originally filed/furnished

    pages* _____ received by this Authority on _____

    pages* _____ received by this Authority on _____

☒ the claims:

    pages _____ as originally filed/furnished

    pages* _____ as amended (together with any statement) under Article 19

    pages* _____ received by this Authority on _____

    pages*   **21-28** _____ received by this Authority on **10-02-2004** _____

☒ the drawings:

    pages   **1-8** _____ as originally filed/furnished

    pages* _____ received by this Authority on _____

    pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

    ☐ the description, pages _____

    ☐ the claims, Nos. _____

    ☐ the drawings, sheets/figs _____

    ☐ the sequence listing *(specify):* _____

    ☐ any table(s) related to the sequence listing *(specify):* _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

    ☐ the description, pages _____

    ☐ the claims, Nos. _____

    ☐ the drawings, sheets/figs _____

    ☐ the sequence listing *(specify):* _____

    ☐ any table(s) related to the sequence listing *(specify):* _____

*   *If item 4 applies, some or all of those sheets may be marked "superseded."*

Form PCT/IPEA/409 (Box No. I) (January 2004)

Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application

☒ claims Nos. 17-19 and 40-42 _____

because:

☐ the said international application, or the said claims Nos. _____
relate to the following subject matter which does not require an international preliminary examination *(specify)*:

☒ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. 17-19, 40-42
are so unclear that no meaningful opinion could be formed *(specify)*:

Claims 17-19 and 40-42 are not acceptable according to PCT
Regulations Article 6 and Rule 6.3, since the claims are not
considered to be clear and concise. The claims should be, but
are not in this case, drafted in terms of the technical
features of the invention. These claims state how a user or an
algorithm *perceives* certain traffic characteristics instead of
stating technical features needed to achieve the above
mentioned traffic characteristics.

☐ the claims, or said claims Nos. _____ are so inadequately supported
by the description that no meaningful opinion could be formed.

☐ no international search report has been established for said claims Nos. _____

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the
Administrative Instructions in that:

the written form ☐ has not been furnished

☐ does not comply with the standard

the computer readable form ☐ has not been furnished

☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with
the technical requirements provided for in the Annex C-*bis* of the Administrative Instructions.

☐ See Supplemental Box for further details.

Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-16, 20-39, 43-48	YES
	Claims		NO
Inventive step (IS)	Claims	1-16, 20-39, 43-48	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-16, 20-39, 43-48	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The invention according to claims 1-48 regards a method and element and radio communications systems for channel resource allocation based on the result of sniffing data objects in order to regain information regarding the size of the data objects.

The amended claims 1-48, of 10-02-2004, have been amended to include tree aspects: Firstly, the claims specify that sniffing is performed on application-level data packets, secondly that the information retrieved is related to application-level data object size and thirdly that the method is performed in an element being included in or connected to a radio network controller of an access network.

The following documents are cited in the International Search Report:
D1: GB 2351874 A
D2: WO 0016573 A1
D2: US 5583869 A
D4: US 5793744 A
D5: US 5359593 A

Document D1 discloses a method for TCP segment size control in a packet data transfer device and radio packet system control which depends on user data occurrence condition. Transfer condition control is conducted by the TCP segment transmission and reception controlling section which acquires a current radio packet transmission size through the radio packet control interface, which is equal to the investigation or sniffing of the claims. If a more efficient transfer of the user data can be realised, a radio resource (re-)allocation is

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box V

performed to improve the throughput. Regarding maximum segment size, there is one for transmission and one for reception, hence the control method is applicable in both uplink and downlink directions. The method may also be used to predict the need of future resources, and further to allocate the necessary resources based on that information.
(see page 9, line 11- page 11, line 6; page 13, line 3-16; page 14, line 5- page 16, line 22; page 17, line 5- page 21, line 13; abstract, figure 3)

Document D3 also shows a method for dynamic allocation of wireless communication resources in response to changing service requirements or system capabilities.

Even though both documents D1 and D3 shows methods and elements for allocation of resources in response to changing service capabilities, none of them use the method of sniffing application-level packets as specified by the amended claims 1-16, 20-39 and 43-48. The methods described by D1 and D3 execute sniffing or measurements of transport level data packets.
Further the amended claims differ from D1 and D3 since the claims specify that the method and element is part of or connected to a radio network controller of an access network.

Thus the claimed invention according to the amended claims 1-16, 20-39 and 43-48 implies an improved effect compared to prior art. Further it is not considered obvious for a person skilled in the art to obtain the invention form the above mentioned documents.

Documents D2, D4 and D5 represent the general state of the art.

CLAIMS

1.   A method of channel resource allocation in a communi-
cations system, the method .c h a r a c t e r i z e d   i n
that the communications system uses one or more switched
channels, switching between rates or channels of different
5   characteristics and that one or more data transmissions to
or from a data provider are investigated or sniffed for in-
formation of one or more application-level data packets,
the information being related to application-level data ob-
ject size, for information related to data object size in
10   element being an element of an access network, the element
further being included in or connected to a radio network
controller of the access network.

2.   The method according to claim 1 c h a r a c t e r -
i z e d   i n   that radio resource allocation is based upon
15   the information related to data object size.

3.   The method according to claim 2 c h a r a c t e r -
i z e d   i n   that resource allocation comprises selection
of one or more channels or channel characteristics.

4.   The method according to any of claims 1—3 c h a r -
20   a c t e r i z e d   i n   that the one or more data transmis-
sions are sniffed or investigated in application-level data
packets.

5.   The method according to any of claims 1—4 c h a r -
a c t e r i z e d   i n   that the one or more data transmis-
25   sions are investigated or sniffed in uplink direction.

6.   The method according to any of claims 1—4 c h a r -
a c t e r i z e d   i n   that the one or more data transmis-
sions are investigated or sniffed in downlink direction.

AMENDED SHEET

7. The method according to any of claims 1-6 c h a r - a c t e r i z e d i n that radio resource management allocates resources based upon prediction from the information related to data object size.

5   8. The method according to claim 7 c h a r a c t e r - i z e d i n that resource allocation comprises selection of one or more channels or channel characteristics.

9. The method according to any of claims 1-8 c h a r - a c t e r i z e d i n that the channel characteristics
10   include at least one of

         - data rate,

         - dedicated or shared usage,

         - scheduling,

         - modulation,

15   - spreading code spreading factor, and

         - transmission power.

10. The method according to any of claims 1-9 c h a r - a c t e r i z e d i n that user or session individual data from the data provider is cached or stored prior to
20   being transmitted over a switched channel.

11. The method according to any of claims 1-10 c h a r - a c t e r i z e d i n that prediction for resource allocation of a switched channel is based on content of cached or stored data.

25   12. The method according to claim 10 or 11 c h a r a c - t e r i z e d i n that the data is cached or stored in association with radio resource management.

AMENDED SHEET

13. The method according to any of claims 1–12 c h a r - a c t e r i z e d i n that data from the data provider is positively or negatively acknowledged towards the data pro- vider and forwarded for transmission over a switched chan- nel.

14. The method according to any of claims 1–13 c h a r - a c t e r i z e d i n that resource allocation prediction of a switched channel is based on amount of acknowledged data.

15. The method according to any of claims 1–14 c h a r - a c t e r i z e d i n that resource allocation prediction is performed for a connection to be established.

16. The method according to any of claims 1–14 c h a r - a c t e r i z e d i n that resource allocation prediction is performed for an established connection.

17. The method according to any of claims 1–16 c h a r - a c t e r i z e d i n that it reduces at least one of de- lay and latency, as perceived by a data receiver at the destination.

18. The method according to any of claims 1–16 c h a r - a c t e r i z e d i n that it reduces at least one of de- lay and latency, as perceived by a data provider.

19. The method according to any of claims 1–16 c h a r - a c t e r i z e d i n that it reduces at least one of de- lay and latency, as perceived by a congestion control algo- rithm.

20. The method according to any of claims 1–19 c h a r - a c t e r i z e d i n that individual user need of chan-

AMENDED SHEET

nel resources is·predicted from the object size related in-
formation.

21. The method according to any of claims 1-19 c h a r -
a c t e r i z e d   i n   that future need of channel re-
sources is retrieved from the object size related informa-
tion before the need appears.

22. The method according to any of claims 1-19 c h a r -
a c t e r·i z e d   i n   that the channel resources are
channel resources required to transmit data packets of the
object of said data object size.

23. An element for channel resource allocation in a commu-
nications system using switched channels, switching between
rates or channels of different characteristics, the element
c h a r a c t e r i z e d   b y   one or more processing en-
tities for investigating or sniffing one or more data
transmissions to or from a data provider for information of
one or more application-level data packets, the information
being related to application-level data object size, and
the element being an element of an access network, the ele-
ment further being included in or connected to a radio net-
work controller of the access network.

24. The element according to claim 23 c h a r a c t e r -
i z e d   b y   circuitry for transferring the information
related to data object size to radio resource management.

25. The element according to claim 23 or 24 c h a r a c -
t e r i z e d   b y   one or more processing entities for al-
locating radio resources based upon the information related
to data object size.

26. The element according to·claim 25 c h a r a c t e r -
i z e d   i n   that resource allocation comprises selection
of one or more channels or channel characteristics.

AMENDED SHEET

27. The element according to any of claims 23-26 c h a r a c t e r i z e d   b y   a radio resource management entity for resource allocation based upon prediction from the information related to data object size.

5   28. The element according to any of claims 23-27 c h a r a c t e r i z e d   b y   one or more processing entities for sniffing or investigating data transmissions in application-level data packets.

29. The element according to any of claims 23-28
10   c h a r a c t e r i z e d   i n   that the one or more data transmissions are investigated or sniffed in uplink direction.

30. The element according to any of claims 23-28 c h a r a c t e r i z e d   i n   that the one or more data
15   transmissions are investigated or sniffed in downlink direction.

31. The element according to any of claims 23-30 c h a r a c t e r i z e d   i n   that the channel characteristics include at least one of

20   – data rate,

          – dedicated or shared usage,

          – scheduling,

          – modulation,

          – spreading code spreading factor, and

25   – transmission power.

32. The element according to any of claims 23-31 c h a r a c t e r i z e d   b y   one or more memory or storage devices for caching or storing user or session individ-

AMENDED SHEET

ual data from the data provider prior to being transmitted over the switched channel.

33. The element according to any of claims 23-32 c h a r a c t e r i z e d b y one or more processing en-
5   tities for resource allocation prediction of a switched channel based on content of cached or stored data.

34. The element according to claim 32 or 33 c h a r a c - t e r i z e d b y one or more memory or storage devices being arranged in association with radio resource manage-
10   ment.

35. The element according to claim 32 or 33 c h a r a c - t e r i z e d b y one or more memory or storage devices being arranged in association with the one or more process- ing entities for investigating or sniffing one or more data
15   requests.

36. The element according to any of claims 23-35 c h a r a c t e r i z e d b y one or more processing en- tities for positively or negatively acknowledging data from the data provider to be forwarded for transmission over a
20   switched channel.

37. The element according to any of claims 23-36 c h a r a c t e r i z e d i n that resource allocation prediction of a switched channel is based on amount of ac- knowledged data.

25   38. The element according to any of claims 23-37 c h a r a c t e r i z e d i n that resource allocation prediction is performed for a connection to be established.

AMENDED SHEET

39. The element according to any of claims 23-37 c h a r a c t e r i z e d   i n   that resource allocation prediction is performed for an established connection.

40. The element according to any of claims 23-39
5   c h a r a c t e r i z e d   i n   that it reduces at least one of delay and latency, as perceived at a destination data receiver.

41. The element according to any of claims 23-39 c h a r a c t e r i z e d   i n   that it reduces at least
10   one of delay and latency, as perceived at a data provider.

42. The element according to any of claims 23-39 c h a r a c t e r i z e d   i n   that it reduces at least one of delay and latency, as perceived by a congestion control algorithm.

15   43. The element according to any of claims 23-42 c h a r a c t e r i z e d   i n   that the element is connected to or included in a radio network controller.

44. The element according to any of claims 23-43 c h a r a c t e r i z e d   b y   one or more processing en-
20   tities for predicting individual user need of channel resources from the object size related information.

45. The element according to any of claims 23-43 c h a r a c t e r i z e d   b y   one or more processing entities for retrieving future need of channel resources from
25   the object size related information before the need appears.

46. The element according to any of claims 23-43 c h a r a c t e r i z e d   i n   that the channel resources are channel resources required to transmit data packets of
30   the object of said data object size.

AMENDED SHEET

47. A radio communications system c h a r a c t e r -
i z e d b y means for carrying out the method in any of
claims 1—22.

48. A radio communications system c h a r a c t e r -
5   i z e d b y a plurality of elements according to any of
claims 23—46.

AMENDED SHEET